

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Original) A time limit function utilization apparatus, comprising:
a first functional block;
a second functional block;
a signal line which connects the first functional block and the second functional block and allows using a desired function that is generated by accessing the first functional block and the second functional block with each other; and
a semiconductor time switch which is interposed in or connected to the signal line, and substantially disables or substantially enables mutual access between the first functional block and the second functional block upon a lapse of a first predetermined time.
2. (Original) The apparatus according to claim 1, wherein the semiconductor time switch substantially disables the mutual access between the first functional block and the second functional block upon the lapse of the first predetermined time, and substantially enables the mutual access between the first functional block and the second functional block upon a lapse of a second predetermined time after an end of the lapse of the first predetermined time.
3. (Original) The apparatus according to claim 1, wherein the semiconductor time switch substantially enables the mutual access between the first functional block and the second functional block upon the lapse of the first predetermined time, and substantially disables the mutual access between the first functional block and the second functional block upon a lapse of a second predetermined time after an end of the lapse of the first predetermined time.
4. (Original) The apparatus according to claim 1, wherein the second functional block is a 1st internal circuit which stores information or a function.
5. (Original) The apparatus according to claim 4, wherein the second functional block further comprises (N-1) internal circuits in addition to the 1st internal circuit, and

when a definition is made such that, regarding a switch characteristic, a first polarity is one of a first switch action “on” to “off” and a second switch action “off” to “on”, and a second polarity is the other of the first switch action and the second switch action,

the semiconductor time switch includes (N-1) first polarity time switches, (N-1) second polarity ordinary switches, and (N-1) first polarity ordinary switches,

1st one of the second polarity ordinary switches is connected between the 1st internal circuit and the first functional block, one terminal of nth one of the second polarity ordinary switches is connected to the nth internal circuit, where n is a natural number,

nth one of the first polarity ordinary switches is connected between the other terminal of the nth one of second polarity ordinary switches and a terminal of (n+1)th one of the second polarity ordinary switches, where n is less than N-1,

nth one of the first polarity time switches simultaneously drives the nth one of the second polarity ordinary switches and the nth one of the first polarity ordinary switches, where n is N-1 or less,

(N-1)th one of the first polarity ordinary switches is connected between (N-1)th one of the second polarity ordinary switches and Nth one of the internal circuits, and

the first polarity time switches operate sequentially from the 1st one to the (N-1)th one of the first polarity time switches.

6. (Original) The apparatus according to claim 4, wherein the second functional block further comprises (N-1) internal circuits in addition to the 1st internal circuit, and

the semiconductor time switch comprises (N) automatic turn-off time switches and (N-1) automatic turn-on time switches,

nth one of the automatic turn-off time switch is connected to nth one of the internal circuits, where n is a natural number,

the nth automatic turn-on time switch is connected between the nth automatic turn-off time switch and the (n+1)th automatic turn-off time switch, where n is N-1 or less, and

the automatic turn-off time switches operate sequentially from the 1st one to Nth one and the automatic turn-on time switches operate sequentially from the 1st one to the (N-1)th one in synchronism with the same ordinal number's one of the automatic turn-off time switches.

7. (Original) The apparatus according to claim 1, further comprising:
a first input/output terminal provided on a midpoint of the signal line, the first functional block and one terminal of the semiconductor time switch being connected to the first input/output terminal; and
a third functional block connected to the other terminal of the semiconductor time switch.

8. (Original) The apparatus according to claim 7, wherein,
when a definition is made such that, regarding a switch characteristic, a first polarity is one of a first switch action “on” to “off” and a second switch action “off” to “on”, and a second polarity is the other of the first switch action and the second switch action,
the semiconductor time switch comprises:
a second polarity ordinary switch connected between the input/output terminal and the second functional block,
a first polarity ordinary switch connected between the input/output terminal and the third functional block, and
a first polarity time switch simultaneously driving the second polarity ordinary switch and the first polarity ordinary switch.

9. (Original) The apparatus according to claim 7, wherein
when a definition is made such that, regarding a switch characteristic, a first polarity is one of a first switch action “on” to “off” and a second switch action “off” to “on”, and a second polarity is the other of the first switch action and the second switch action,
the semiconductor time switch comprises:
a second polarity time switch connected between the input/output terminal and the second functional block, and
a first polarity time switch connected between the input/output terminal and the third functional block.

10. (Original) The apparatus according to claim 1, wherein

the semiconductor time switch comprises a source region and a drain region formed apart from each other on a semiconductor layer, and a gate electrode insulatively formed on a channel region between the source region and the drain region,

the source region and the drain region are used as two connection terminals of the semiconductor time switch, and

one of the source region and the drain region is connected to the first functional block and the other of the source region and the drain region is connected to the second functional block.

11. (Original) The apparatus according to claim 10, wherein in the semiconductor time switch, the channel region between the source region and the drain region is rendered conductive or nonconductive by supplying charges to the gate electrode in advance, the charges are removed from the gate electrode over time, and the channel region between the source region and the drain region is rendered nonconductive or conductive upon the lapse of the first predetermined time.

12. (Original) The apparatus according to claim 11, wherein the charges are injected into or leak from the gate electrode via one selected from the group consisting of a p-n junction, a pnp junction, an n^+nn^+ junction, a p^+pp^+ junction, an npn junction, and a Schottky junction.

13. (Original) The apparatus according to claim 11, wherein the gate electrode is covered with an insulating member, and the charges are injected into or leak from the gate electrode via the insulating member.

14. (Original) A semiconductor integrated circuit comprising:
an aging circuit configured by parallel-connecting a plurality of aging devices in which an age-based change occurs while a power supply is disconnected, and an output signal sensed in read changes over time; and
a sense circuit comparing the output signal from the aging circuit with a reference signal.

15. (Original) The circuit according to claim 14, wherein when a time until an output signal from each of the aging devices reaches a predetermined level is defined as a life time of

each of the aging devices and a time until the output signal from the aging circuit reaches a level of the reference signal is defined as a life time of the aging circuit, the level of the reference signal is so set as to make the life time of the aging circuit longer than an average life time of the aging devices.

16. (Original) The circuit according to claim 14, wherein a level of the reference signal is set to a value smaller by a predetermined offset amount than a value at which the output signal from the aging circuit is maximized upon a lapse of a time, or a value larger by a predetermined offset amount than a value at which the output signal from the aging circuit is minimized upon a lapse of a time.

17. (Original) The circuit according to claim 14, which further comprises a memory that stores the reference signal, and in which a level of the reference signal stored in the memory is adjusted to control a life time of the aging circuit.

18. (Original) The circuit according to claim 14, wherein the aging device has a charge accumulation layer accompanied by leakage while the power supply is disconnected.

19. (Original) The circuit according to claim 14, wherein the aging device is configured by series-connecting a plurality of field effect devices each having a charge accumulation layer accompanied by leakage while the power supply is disconnected.

20. (Original) The circuit according to claim 14, wherein
the aging circuit comprises a first sub-aging circuit configured by parallel-connecting a plurality of first aging devices in which the output signal decreases over time, and a second sub-aging circuit configured by parallel-connecting a plurality of second aging devices in which the output signal increases over time,

the first sub-aging circuit and the second sub-aging circuit are series-connected, and

when a time until the output signal from the first sub-aging circuit reaches a first predetermined level is defined as a life time of the first sub-aging circuit and a time until the second sub-aging circuit reaches a second predetermined level is defined as a life time of

the second sub-aging circuit, the life time of the first sub-aging circuit is longer than the life time of the second sub-aging circuit.

21. (Original) The circuit according to claim 14, wherein
the aging circuit comprises a first sub-aging circuit configured by parallel-connecting a plurality of first aging devices in which the output signal decreases over time, and a second sub-aging circuit configured by parallel-connecting a plurality of second aging devices in which the output signal increases over time,
the first sub-aging circuit and the second sub-aging circuit are parallel-connected, and
when a time until the output signal from the first sub-aging circuit reaches a predetermined level is defined as a life time of the first sub-aging circuit and a time until the second sub-aging circuit reaches the predetermined level is defined as a life time of the second sub-aging circuit, the life time of the first sub-aging circuit is shorter than the life time of the second sub-aging circuit.

22. (Original) The circuit according to claim 14, further comprising a memory area where correspondence codes of the output signal from the aging circuit and lapsed times are stored in advance, and
the sense circuit compares the output signal from the aging circuit with the correspondence codes stored in the memory area, and senses a lapsed operation time of the aging circuit.

23. (Original) The circuit according to claim 14, wherein the aging circuit comprises N sub-aging circuits each having a different life time from others defined by a time until an added output signal within each of the N sub-aging circuits reaches a predetermined reference signal set for each of the N sub-aging circuits, and
the sense circuit compares the added output signal from each of the N sub-aging circuits with the predetermined reference signal, and senses whether or not each of the N sub-aging circuit closes a life time thereof.

24. (Original) The circuit according to claim 23, wherein

each of the N sub-aging circuits has the different life time from others by a predetermined time which is obtained by dividing, by N, a difference between the shortest life time and the longest life time among the N sub-aging circuits, and

the sense circuit senses a lapsed operation time of the aging circuit by sensing each of the life times of the N sub-aging circuits.

25. (Withdrawn) A semiconductor integrated circuit comprising:

a plurality of aging devices in which an age-based change occurs while a power supply is disconnected, and output signals sensed in read change over time;

a plurality of operational circuits arranged in correspondence with the plurality of aging devices, and having at least three terminals, respectively, first terminals of which receive the output signals from the plurality of aging devices;

a plurality of first memory areas electrically connected to second terminals of the plurality of operational circuits, respectively, and each storing at least one predetermined signal level;

an adder electrically connected to third terminals of the plurality of operational circuits and adding the output signals from the plurality of operational circuits appearing at the third terminals;

a plurality of circuit breakers which cut off output signals from the plurality of aging devices before the adder receives the output signal on the basis of operational results of the plurality of operational circuits that are obtained by comparing the output signals from the plurality of aging devices with the at least one predetermined signal level;

a second memory area where a predetermined reference signal is stored, and

a sense circuit which compares an output signal from the adder and the reference signal stored in the second memory.

26. (Withdrawn) The circuit according to claim 25, wherein

each of the plurality of circuit breakers includes a trimming transistor with a two-layered gate structure which has a first diffusion layer and a second diffusion layer formed apart from each other on a semiconductor substrate, a first gate electrode formed via a first insulating film on the semiconductor substrate between the first diffusion layer and the second diffusion layer, and a second gate electrode formed on the first gate electrode via a

second gate insulating film, the first diffusion layer being electrically connected to a corresponding one of the output terminals of the plurality of aging devices,

the second diffusion layer of the trimming transistor is electrically connected to a corresponding one of the first terminals of the plurality of operational circuits,

the plurality of the operational circuits have forth terminals, respectively, and the second gate electrode of the trimming transistor is electrically connected to a corresponding one of the fourth terminals of the plurality of operational circuits, and

the plurality of operational circuits compare the output signals of the plurality of aging devices via the trimming transistor with the signal level stored in the first memory areas, and inject charges into or emit the charges from the first gate electrode of the trimming transistor on the basis of a comparison result.

27. (Withdrawn) The circuit according to claim 26, wherein

each of the plurality of aging devices comprises a third diffusion layer and a fourth diffusion layer formed apart from each other on a semiconductor substrate, a third gate electrode formed via a third insulating film on the semiconductor substrate between the third diffusion layer and the fourth diffusion layer, and a fourth gate electrode formed on the third gate electrode via a fourth gate insulating film,

one of the third diffusion layer and the fourth diffusion layer of each of the plurality of aging devices is shared with the first diffusion layer of the trimming transistor, and

a film thickness of the third gate insulating film of each of the plurality of aging devices is smaller than a film thickness of the first gate insulating film of the trimming transistor.

28. (Withdrawn) The circuit according to claim 25, wherein

each of the plurality of circuit breakers includes a trimming transistor having a first diffusion layer and a second diffusion layer formed apart from each other on a semiconductor substrate, a first gate electrode formed via a first insulating film on the semiconductor substrate between the first diffusion layer and the second diffusion layer, the first diffusion layer being electrically connected to an output terminal of a corresponding one of the aging devices, and

the plurality of operational circuits compare the output signals of the aging devices each input via the trimming transistor with the signal level stored in the first memory areas, and cut, on the basis of a comparison result, electrical connection between a corresponding one of the plurality of operational circuits and the trimming transistor or electrical connection between the corresponding one of the plurality of operational circuits and an adder.

29. (Withdrawn) The circuit according to claim 25, wherein each of the plurality of circuit breakers includes a cutting trace at which interconnection between a corresponding one of the third terminals of the operational circuits and the adder or between the corresponding pair of the plurality of aging devices and the plurality of operational circuits is cut.

30. (Withdrawn) The circuit according to claim 25, further comprising a plurality of third memory areas where a result of comparing by the operational circuits the output signals of the aging devices input into the operational circuits and the predetermined signal level(s) stored in the first memory areas is stored, wherein

each of the plurality of circuit breakers includes a trimming transistor which has a first diffusion layer and a second diffusion layer formed apart from each other on a semiconductor substrate, a first gate electrode formed via a first insulating film on the semiconductor substrate between the first diffusion layer and the second diffusion layer, the first diffusion layer being electrically connected to an output terminal of a corresponding one of the aging devices.

31. (Withdrawn) The circuit according to claim 25, wherein when a time until each of the output signals of the plurality of aging devices reaches the predetermined signal level stored in the first memory areas is defined as a life time of each of the plurality of aging devices, and a time until the output signal from the adder reaches a level of the reference signal stored in the second memory area is defined as a life time of the aging circuit, the life time of the aging circuit is controlled by adjusting the predetermined signal level stored in the first memory areas.